OMI Level 2 O_2-O_2 Cloud Data Product Specification

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1 Introduction

1.1 Purpose of the document

This document specifies the OMI Level 2 O_2-O_2 Cloud data product. This product will be produced by the OMI O2-O2 Cloud software, as described in AD1. Along with this document there is also sample software and product samples. The Zip archive containing the sample software and product samples can be requested by sending an e-mail to veefkind@knmi.nl .

1.2 Definitions, acronyms and abbreviations

DOAS	Differential Optical Absorption Spectroscopy
ECS	EOS Core System
HDF	Hierarchical Data Format
HDF-EOS	Hierarchical Data Format - Earth Observing System
NRT	Near Real Time
ODL	Object Description Language
OMI	Ozone Monitoring Instrument
ONVS	Ozone Near-real-time and Very-fast-delivery System.
PGE	Product Generation Executive
SAA	South Atlantic Anomaly
SDP	Science Data Production
TAI	International Atomic Time

1.3 References

1.3.1 Applicable Documents

AD1 URD for the OMI Ozone Near-Real-Time and Very-Fast-Delivery System

AD2 HDF-EOS Aura File Format Guidelines, NCAR SW-NCA-079, Version 1.3, 27 August 2003.

1.3.2 Reference Documents

RD1 HDF-EOS Interface Based on HDF5, 175-TP-511-003, May 2002.

RD2 Release 6A.07 SDP Toolkit Users Guide for the ECS Project, 333-CD-605-001, May 2002.

RD3 OMI Level 1B Product Format Specification, SE-OMIE-0562-DS/02, issue 1 (draft 7), 9 August, 2002.

RD4 Near Real-Time SSM/I EASE-Grid Daily Global Ice Concentration and Snow Extent, March 2002, URL: http://nsidc.org/data/docs/daac/nise1_nise.gd.html

RD5 OMIS Activity Definitions, RP-OMIE-KNMI-335, Issue 1, June 17 2002.

RD6 Release 6A.07 Toolkit Users Guide for the ECS Project, 333-CD-605-001, p. 6-310, May 2002.

1.4 Overview of the document

This document is laid out as follows:
Chapter 1 is the introduction.
Chapter 2 gives a general overview of the product.
Chapter 3 describes the product data file format and contents.
Chapter 4 describes the product metadata file.

2 Overview of the product.

The OMI Level 2 O_2-O_2 Cloud Product contains geolocated information on the cloud fractions and cloud pressure. In addition, it also contains intermediate results, such as fitting diagnostics, slant column densities etc.. Also, the product contains metadata. Every OMI Level 2 O_2-O_2 Cloud Product consists of two files: the data file which contains the actual data and metadata, and a metadata file which contains a subset of the metadata. The metadata file is used to search data archives like the NASA DAAC. The format of the data files are developed according to the guidelines given in AD2. The metadata file is produced by calling the SDP Toolkit [RD2] library.

2.1 Product Identifier

The identifier for the OMI O2-O2 Cloud product as provided by the OMI Science Support Team is "OMCLDO2" for global products and "OMCLDO2Z" (TBC) for zoom products.

2.2 File Names

The file name convention is specified in AD2. OMI file names will have 4 sections within the basis of the file name. Each section will be delimited by an *underscore*. The suffix will follow the basis and be delimited by a period. The four sections in the basis are Instrument ID, Data Type, Data ID and Version. Thus, the filename is constructed in the following way:

<InstrumentID>_<DataType>_<DataID>_<Version>.<Suffix>

In Table 1 details the contents of the four sections and the suffix are given. The following is an example of a file name:

OMI-Aura_L2-OMCLDO2_2004m0601t0732-o01696_v002-2004m0612t124127.he5

Table 1. Description of the different sections and the suffix of the filename.

Section	Format	Description
InstrumentID	"OMI-Aura"	ID for instrument and spacecraft.
DataType	"L2-OMCLDO2" for global products "L2-OMCLDO2Z" (TBC) for zoom producs	Level and product indicators
DataID	<start date and time>-o<orbit>	date and orbit indicators: date-time format: <yyyy>m<mmdd>t<hhmm> orbit format o<nnnnn>
Version	v<version>-<production date and time>	version indicators: version format <nnn> date-time format: <yyyy>m<mmdd>t<hhmmss>
Suffix	"he5" or "he5.met"	Suffixes for product file and metadata file.

3 The Data File

3.1 Description

The OMI Level 2 cloud product data file contains the data and metadata produced by the OMI O2-O2 Cloud software, as described in AD1. The input for this product can either be Global or Zoom-in OMI Level 1B products.

3.2 Format

The format of the data file is HDF-EOS 5, as described in RD1. To ease the use of Aura data sets, the Aura teams have agreed to make their files match as closely as reasonably possible. To this end, the Aura teams have agreed on a set of guidelines for their file formats, which are described in AD2.

3.3 Structure

The data file uses HDF-EOS Swath[1] format. The number of Swath structures used in the data file depends on the L1B input product. If the product is produced from an OMI Global Level 1B product, the file contains a single swath structure named "CloudFractionAndPressure". Figure 1 shows an example of the structure of a data file produced from Global data.
If the product is produced from an OMI Zoom-in Product the file may contain more than one swath structures. The names of these swaths always starts with "CloudFractionAndPressure", and is followed by the <Size> identifier that follows the L1B Zoom product [RD3]. The <Size> identifier has the following format:

"<number_of_rows>"x"<position_of stop_column>"x"<binning_factor>.

An example of a swath name in the O_2-O_2 Cloud product in case of a zoom product is:

"CloudFractionAndPressure 60x792x4".

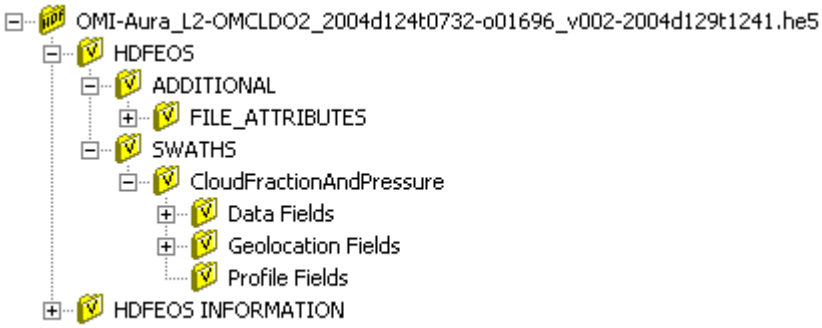

Figure 1. Structure of a product data file.

3.4 Swath Structure

Each Swath structure consists of data fields, geolocation fields and profile fields. In this product no profile fields are used. All data and geolocation fields are defined by their type, dimension and attributes. The dimensions that are used are listed in Table 2. The nTimes, nXtrack and nTimesSmallPixel dimensions are identical to those used in the Level 1B radiance files. In HDF a dimension can either be fixed or unlimited. Fixed indicates that the dimension is determined when the file is created. Unlimited indicates that the dimension can grow and thus not has to be determined when the file is created. For the dimensions nTimes, nTimesSmallPixelUV and

[1] Note that in the OMI community 'swath' is often referred to as the across track direction. However, in this document the 'swath' is only used for HDF-EOS elements, see RD1.

nTimesSmallPixelVIS the size is not known at file creation, because parts of the orbit can be processed by the Level 1-2 software, therefore these dimensions are set to unlimited. As a service to the user, the actual size of the nTimes, nTimesSmallPixelUV and nTimesSmallPixelVIS are stored as the Swath level attributes NumTimes, NumTimesSmallPixelUV and NumTimesSmallPixelVIS. The reason for this is that the size of unlimited dimension can otherwise not be retrieved using the HDF-EOS library. Note that this is possible using the plain HDF library calls. Besides the size of the unlimited dimensions, there is also a swath level attribute to indicate the vertical coordinate. This is a mandatory attribute from AD2 and is set to "Total Column" to indicate that the datafields do not have a pressure or altitude dimension. The Swath level attributes are listed in Table 3, their names and types follow the Level 1B products.

All data and geolocation fields have attributes. The attributes for data and geolocation fields are listed in Table 4. In case the data is missing, fill values are used. These fill values depend on the data type. Table 5 shows a list of the fill values for all the types used in the product.

Table 2. Dimensions of the Swath structures.

Dimension Name	Size	Dimension Description
nTimes	unlimited	Number of OMI measurements
nXtrack	fixed	Number of ground pixels per measurement
nTimesSmallPixelUV	unlimited	Number of OMI small pixel measurements in the UV channel
nTimesSmallPixelVIS	unlimited	Number of OMI small pixel measurements in the VIS channel

Table 3. Swath level attributes.

Dimension Name	Size	Dimension Description
NumTimes	HE5T_NATIVE_INT32	Actual size of the dimension nTimes
NumTimesSmallPixelUV	HE5T_NATIVE_INT32	Actual size of the dimension nTimesSmallPixelUV
NumTimesSmallPixelVIS	HE5T_NATIVE_INT32	Actual size of the dimension nTimesSmallPixelVIS
VerticalCoordinate	HE5T_NATIVE_CHAR	"Total Column"

Table 4. Data and geolocation field attributes.

Attribute name	Attribute Type	Attribute Description
MissingValue	Same type as data Field	Contains the value for missing data
Title	HE5T_NATIVE_CHAR	Title of the field
Units	HE5T_NATIVE_CHAR	Units after applying scales and offsets.
ScaleFactor	HE5T_NATIVE_FLOAT	Factor for scaling data
Offset	HE5T_NATIVE_FLOAT	Value to add to the data
UniqueFieldDefinition	HE5T_NATIVE_CHAR	Describes if definition of field is shared with other Aura Instruments ("Aura-Shared", "X-Specific", where X=Instrument Name, "X-Y[-Z]-Shared" where X,Y, and optional Z are instrument names (in alphabetical order)

Table 5. Fill values.

Data Type	Fill Value
HE5T_NATIVE_INT8	-127
HE5T_NATIVE_UINT8	255
HE5T_NATIVE_INT16	-32767
HE5T_NATIVE_UINT16	65535
HE5T_NATIVE_INT32	-2147483647
HE5T_NATIVE_UINT32	4294967295
HE5T_NATIVE_FLOAT	-2^{100} (-0X1P+100)
HE5T_NATIVE_DOUBLE	-2^{100}(-0X1P+100)

3.4.1 Geolocation Fields

The geolocation fields are stored in the Geolocation Fields group of the Swath structure. Table 6 Gives a description of the Geolocation Fields. In Table 7 the usage of the bit fields of the GroundPixelQualityFlags geolocation field are given. For detailed information of the Snow/Ice flags and the Land/Water flags used in the GroundPixelQualityFlags, see RD4 and RD6. For each of the fields the UniqueFieldDefinition (see Table 4) indicates if a field is shared with other instruments, see AD2. The default value is "OMI-Specific". In case of a shared field, this is indicated as note in the first column of Table 6.

Table 6. The Geolocation Fields.

Name	Type	Dimensions	Unit	Description
Time [s]	HE5T_NATIVE_DOUBLE	nTimes	second	Time in TAI-93 format.
Latitude [s]	HE5T_NATIVE_FLOAT	nTimes, nXtrack	deg	Latitude of the center of the groundpixel
Longitude [s]	HE5T_NATIVE_FLOAT	nTimes, nXtrack	deg (-180 to 180)	Longitude of the center of the groundpixel
SpacecraftLatitude [hot]	HE5T_NATIVE_FLOAT	nTimes	deg	Geodetic Latitude above WGS84 ellipsoid
SpacecraftLongitude [hot]	HE5T_NATIVE_FLOAT	nTimes	deg (-180 to 180)	Geodetic Longitude above WGS84 ellipsoid
SpacecraftAltitude [hot]	HE5T_NATIVE_FLOAT	nTimes	m	Altitude above WGS84 ellipsoid
SolarZenithAngle [s]	HE5T_NATIVE_FLOAT	nTimes, nXtrack	deg	Solar zenith angle at WGS84 ellipsoid for center co-ordinate of the ground pixel
SolarAzimuthAngle [ot]	HE5T_NATIVE_FLOAT	nTimes, nXtrack	deg	Solar azimuth angle at WGS84 ellipsoid for center co-ordinate of the ground pixel, defined East-of-North
ViewingZenithAngle	HE5T_NATIVE_FLOAT	nTimes, nXtrack	deg	Viewing zenith angle at WGS84 ellipsoid for center co-ordinate of the ground pixel
ViewingAzimuthAngle	HE5T_NATIVE_FLOAT	nTimes, nXtrack	deg	Viewing azimuth angle at at WGS84 ellipsoid for center co-ordinate of the ground pixel, defined Eastof-North
TerrainHeight	HE5T_NATIVE_INT16	nTimes, nXtrack	m	Terrain height at for center co-ordinate of the ground pixel
GroundPixelQualityFlags	HE5T_NATIVE_UINT16	nTimes, nXtrack	NoUnits	See Table 7.

[s]) UniqueFieldDefinition = "Aura-Shared"
[hot]) UniqueFieldDefinition = "HIRLDS-OMI-TES-Shared"
[ot]) UniqueFieldDefinition = "OMI-TES-Shared"

Table 7. Definition of the GroundPixelQualityFlags

Bit	Description
0-3	Land/Water flags [RD6] 0=Shallow Ocean 1=Land

	2=Shallow Inland Water 3=Ocean coastline / Lake shoreline 4=Ephemeral (intermittent) water 5=Deep Inland Water 6=Continental Shelf Ocean 7=Deep Ocean 8-14=Not used 15=Error flag for Land/Water
4	Sun Glint Possibility flag
5	Solar Eclipse possibility flag
6	Geolocation Error flag
7	Reserved for future use
8-14	Snow/Ice flags [based on NISE, RD5] 0=Snow-free land 1-100=Sea ice concentration (%) 101=Permanent ice (Greenland, Antarctica) 102=Not used 103=Dry snow 104=Ocean [NISE-255] 105-123=Reserved 124=Mixed pixels at coastline [NISE-252] 125=Suspect ice value [NISE-253] 126=Corners (undefined) [NISE-254] 127=Error
15	NISE nearest neighbor filling flag 0=Not set 1=Set

3.4.2 Data Fields

The data fields are stored in the Data Fields group of the Swath structure. Table 8 Gives a description of the Data Fields. Table 9 and Table 10 give the detailed bit-level description of the MeasurementQualityFlags and ProcessingQualityFlags. As for the geolocation fields, the notes in the first column of Table 8 indicate that the UniqueFieldDefinition differs from the default value, which is "OMI-Specific".

Table 8. The Data Fields.

Name	Type	Dimensions	Unit	Description
CloudFraction	HE5T_NATIVE_FLOAT	nTimes, nXtrack	NoUnits	Effective cloud fraction, clipped to 0 to 1
CloudFractionNotClipped	HE5T_NATIVE_FLOAT	nTimes, nXtrack	NoUnits	Effective cloud fraction
CloudFractionPrecision	HE5T_NATIVE_FLOAT	nTimes, nXtrack	NoUnits	Precision of effective cloud fraction
CloudPressure	HE5T_NATIVE_INT16	nTimes, nXtrack	hPa	Effective cloud pressure.
CloudPressurePrecision	HE5T_NATIVE_INT16	nTimes, nXtrack	hPa	Precision of the effective cloud pressure.
SlantColumnAmountO2O2	HE5T_NATIVE_FLOAT	nTimes, nXtrack	molecule ^{2} cm^{-5}	O_2-O_2 slant column density, scaled by a factor 10^{-43}
SlantColumntAmountO2O2Precision	HE5T_NATIVE_FLOAT	nTimes, nXtrack	molecule ^{2} cm^{-5}	Precision of the O_2-O_2 slant column density, scaled by a factor 10^{-43}

ContinuumAtReference Wavelength	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	NoUnits	Continuum value at reference wavelength
ContinuumAtReference WavelengthPrecision	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	NoUnits	Precision of Continuum value at reference wavelength
SlantColumnAmountO3	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	DU	O_3 slant column density from DOAS fit
SlantColumntAmountO3 Precision	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	DU	Precision of the O_3 fiited slant column density
RingCoefficient	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	molecule cm^{-2}	Ring coefficient from DOAS fit
RingCoefficientPrecision	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	molecule cm^{-2}	Ring coefficient precision from DOAS fit
TerrainPressure	HE5T_NATIVE_ INT16	nTimes, nXtrack	hPa	Pressure of the center of the ground pixel.
TerrainReflectivity	HE5T_NATIVE_ INT8	nTimes, nXtrack	NoUnits	Reflectivity of the ground pixel scaled by a factor 100
SnowIceExtent	HE5T_NATIVE_ UINT8	nTimes, nXtrack	NoUnits	Snow Ice extent information. Uses the NISE convention [RD4]
ChiSquaredOfFit	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	NoUnits	Chi-squared diagnostics of DOAS fit.
RootMeanSquareErrorOf Fit	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	NoUnits	Root-mean-square error of DOAS fit
MeasurementQualityFlag s	HE5T_NATIVE_ UINT8	nTimes	NoUnits	See Table 9
ProcessingQualityFlags	HE5T_NATIVE_ UINT16	nTimes, nXtrack	NoUnits	See Table 10
MeanSunNormalizedRadi ance	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	photons/ (s.nm.cm^2.sr)	Mean Sun Normalized Radiance over the DOAS Fit Window
SmallPixelVarianceUV	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	NoUnits	Relative variance of the radiance of the small pixel data of the UV channel
SmallPixelVarianceVIS	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	NoUnits	Relative variance of the radiance of the small pixel data of the VIS channel
SmallPixelMeanUV	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	photons/ (s.nm.cm^2.sr)	Mean of the radiance of the small pixel data of the UV channel
SmallPixelMeanVIS	HE5T_NATIVE_ FLOAT	nTimes, nXtrack	photons/ (s.nm.cm^2.sr)	Mean of the radiance of the small pixel data of the VIS channel
SmallPixelRadianceUV	HE5T_NATIVE_ FLOAT	nTimesSmal lPixelUV, nXtrack	photons/ (s.nm.cm^2.sr)	Radiance of small pixel data column of UV Channel
SmallPixelRadianceVIS	HE5T_NATIVE_ FLOAT	nTimesSmal lPixelVIS, nXtrack	photons/ (s.nm.cm^2.sr)	Radiance of small pixel data column of VIS channel
SmallPixelWavelengthU V	HE5T_NATIVE_ UINT16	nTimesSmal lPixelUV, nXtrack	nm	Wavelength of small pixel radiance of UV channel, scaled by a factor 100
SmallPixelWavelengthVI S	HE5T_NATIVE_ UINT16	nTimesSmal lPixelVIS, nXtrack	nm	Wavelength of small pixel radiance of VIS channel, scaled by a factor 100
NumberOfSmallPixelCol umnsUV	HE5T_NATIVE_ INT8	nTimes	NoUnits	Number of small pixels for current measurement.
NumberOfSmallPixelCol	HE5T_NATIVE_	nTimes	NoUnits	Number of small pixels for current

umnsVIS	INT8			measurement.
InstrumentConfigurationId	HE5T_NATIVE_UINT8	nTimes	NoUnits	Unique ID for instrument settings for current measurement, see [RD5].

Table 9. Definition of the MeasurementQualityFlags

Bit	Name	Description
0	Measurement Missing Flag 0 Not set 1 Set	Set if all Ground Pixels give Earth Radiance Missing Flag.
1	Measurement Error Flag 0 Not set 1 Set	Set if any of the L1B MeasurementQualityFlags bit 0, 1 or 3 are set for the Radiance or for the used Solar product.
2	Measurement Warning Flag 0 Not set 1 Set	Set if any of the L1B MeasurementQualityFlags bit 2, 4, 5, 8, 9 are set for the Radiance or for the used Solar product.
3	Rebinned Measurement Flag 0 Not set 1 Set	Set if L1B radiance MeasurmentQualityFlags bit 7 is set to 1.
4	SAA Flag 0 Not set 1 Set	Set if L1B MeasurmentQualityFlags bit 10 is set to 1, for the Radiance or for the used Solar product
5	Spacecraft Maneuver Flag 0 Not set 1 Set	Set if L1B MeasurmentQualityFlags bit 11 is set to 1, for the Radiance or for the used Solar product
6	Instrument Settings Error Flag 0 Not set 1 Set	The Earth and Solar InstrumentConfigurationIDs are not compatible.
7	Reserved	Reserved

Table 10. Definition of the ProcessingQualityFlags.

Bit	Name	Description
0	Solar Irradiance Warning Flag 0 Not set 1 Set	For any of the irradiance pixels contained in the fit window: - L1B PixelQualityFlags bit 6-10 is set - wavelenghtPrecision > maxWavelengthPrecision - wavelengthPrecision <= 0 - wavelengthPrecision contains fill value - irradiancePrecision > maxIrradiancePrecision - irradiancePrecision <= 0 - irradiancePrecision contains fill value
1	Earth Radiance Missing Flag 0 Not set 1 Set	For this ground pixel the number of spectral pixels flagged with the L1B PixelQualityFlags bit 0 is larger than threshold set in the OPF, or, the number of spectral pixels is too small to perform the fitting.
2	Earth Radiance Error Flag 0 No error 1 Error	For this ground pixel the number of spectral pixels flagged with the L1B PixelQualityFlags bit 0-5 is larger than a threshold set in the OPF.
3	Earth Radiance Warning Flag 0 Not set 1 Set	For any of the radiance pixels contained in the fit window: - L1B PixelQualityFlags bit 6-10 is set - wavelenghtPrecision > maxWavelengthPrecision - wavelengthPrecision <= 0 - wavelengthPrecision contains fill value - radiancePrecision > maxRadiancePrecision - radiancePrecision <= 0

		- radiancePrecision contains fill value - Any of the radiance or geolocation fileds used is out-of-bounds
4	No Snow/Ice Data Flag 0 Not set 1 Set	Snow Ice data from cloud product missing or invalid.
5	DOAS Fit Error Flag 0 Not set 1 Set	SCD fit returned error
6	DOAS Fit Warning Flag 0 Not set 1 Set	Any of the following occurrences: • O_2-O_2 SCD precision > maxO2O2SCDPrecision • ContinuumAtReferenceWavelengthPrecision > maxContinuumAtReferenceWavelengthPrecision • RMS Error > RMSErrorFlag • O_2-O_2 SCD covariance > max O2O2SCDCovariance • ContinuumAtReferenceWavelength covariance > max ContinuumAtReferenceWavelength covariance • O_2-O_2 SCD is less than minO2O2SCD or SCD is larger than maxO2O2SCD • ContinuumAtReferenceWavelength is less than min ContinuumAtReferenceWavelength or larger than max ContinuumAtReferenceWavelength
7	Cloud Fraction Missing Flag 0 Not set 1 Set	Cloud Fraction computation failed.
8	Cloud Fraction Warning Flag 0 Not set 1 Set	Any of the following: • SCD Warning Flag set • Cloud Fraction computation returned warning • Cloud Fraction less than minCF or cloud fraction is larger than maxCF • Cloud Fraction precision > maxCFprecision
9	Cloud Pressure Missing Flag 0 Not set 1 Set	Cloud Pressure computation failed.
10	Cloud Pressure Warning Flag 0 Not set 1 Set	Any of the following: • SCD Warning Flag set • Cloud Pressure computation returned warning • Cloud Pressure less than minCP or cloud pressure is larger than maxCP Cloud Pressure precision > maxCPprecision
11	Extrapolation Warning Flag	Any of the following: Cloud Fraction was obtained by extrapolation of the LUT Cloud Pressure was obtained by extrapolation of the LUT
12	Cloud Fraction Clipped Warning Flag	Set when the cloud fraction is larger than 1.0 or smaller than 0.0. In these cases the CloudFraction field is clipped to 0 or 1.
13	Reserved	Reserved
14	Reserved	Reserved
15	Reserved	Reserved

3.5 Metadata

In this document the term "metadata" is reserved for metadata on file (granule) level. Examples of metadata on granule level are the date and time that the data was measured, the percentage of the data that is missing for the granule, the geographic coverage, etc..
The metadata is implemented in two ways:

1. as HDF-EOS file level attributes
2. as ECS metadata.

The metadata fields that are implemented as HDF-EOS file level attributes are only available in the data file, whereas part of the ECS metadata fields are stored both in the data and in the metadata file. The advantage of storing a metadata field as HDF-EOS file attributes are that they are easily available for the users. Another advantage of using HDF-EOS file attributes is that there are no iterations needed with ECS to change or add such a metadata field. The ECS metadata on the other hand have the advantage that they are ingested by the ECS system (via the metadata file), and can be used for searching the DAAC archive. There are three types of ECS metadata:

1. Collection
2. Inventory
3. Archived.

The collection type metadata describe the collection of all the product files. Thus, collection metadata fields described in this document are the same for all the granules for the OMI Level 2 O2-O2 Cloud Product. The collection level metadata consist of fields like the instrument name ("OMI"), the platform name ("EOS-Aura"), etc.. The Inventory metadata describe a single granule. It contains standard ECS fields, as well as the so-called product specific attributes. Like the product specific attributes, the archive metadata can also be defined per product. The difference between archive and inventory metadata is that archive metadata cannot be used for searching the DAACs. Furthermore, the Archive level attributes are not part of the metadata file, whereas the Collection and Inventory metadata are contained in the metadata file. The Collection, Inventory and Archive ECS metadata are listed in Tables, 11, 12 and 13, respectively.

The HDF-EOS file attributes are stored in the "FILE_ATTRIBUTES" group, see Figure 1. The parameters that are stored as Global Attributes are listed in Table 14. Some of these parameters are also part of the ECS metadata, like for instance the the GranuleDay, GranuleMonth, GranuleYear attributes. The reason of this duplication is that the Global Attributes provide a simpler interface to this information.

Table 11. Collection metadata.

Name	**Value**
DLLName	libDsESDTOmOMIPoly.001Sh.so
SpatialSearchType	Orbit
ShortName	"OMCLDO2" or "OMCLDO2Z"
LongName	"OMI/Aura Cloud Pressure and Fraction (O2-O2 Absorption) 1-Orbit L2 Swath 13x24km" for global products "OMI/Aura Cloud Pressure and Fraction (O2-O2 Absorption) 1-Orbit L2 Swath 13x12km" for zoom products
CollectionDescription	Cloud pressure and fraction measured with OMI using O2-O2 absorption band at 477 nm and the DOAS technique
VersionID	1.0
RevisionDate	2004-01-12
SuggestedUsage	Sience Research
ProcessingCenter	OMI SIPS
ArchiveCenter	GSFC
VersionDescription	Pre-launch test using simulated and on-ground-acquired data
CitationforExternalPublication	OMI data contained herein were obtained through joined research between the Netherlands (NIVR/KNMI), Finland (FMI), and the U.S. (NASA) in the Earth Observing System (EOS) Aura Mission
CollectionState	In Work

MaintenanceandUpdateFrequency	Continually
TimeType	UTC
DateType	Gregorian
TemporalRangeType	Continuous Range
PrecisionofSeconds	001
RangeBeginningDate	2000-01-01
RangeBeginningTime	00:00:00.000000
RangeEndingDate	2000-01-01
RangeEndingTime	00:00:00.000000
ContactOrganizationContainer.Role	Archive
ContactOrganizationContainer.HoursofService	08:00 to 18:00:00 EDT (-0500 GMT)"
ContactOrganizationContainer.ContactInstructions	Contact for format/distribution issues
ContactOrganizationContainer.ContactOrganizationName	Goddard DAAC User Services
ContactOrganizationAddressContainer.StreetAddress	NASA/GSFC Code 902
ContactOrganizationAddressContainer.City	GREENBELT
ContactOrganizationAddressContainer.StateProvince	MD
ContactOrganizationAddressContainer.PostalCode	20771
ContactOrganizationAddressContainer.Country	USA
OrganizationTelephoneContainer.TelephoneNumber	301-614-5473
OrganizationTelephoneContainer.TelephoneNumberType	Voice
OrganizationTelephoneContainer.TelephoneNumber	301-614-5304
OrganizationTelephoneContainer.TelephoneNumberType	Facsimile
OrganizationEmail.ElectronicMailAddress	daac_usg@gsfcsrvr4.gsfcmo.ecs.nasa.gov
ECSDisciplineKeyword	Earth Science
ECSTopicKeyword	Atmosphere
ECSTermKeyword	Clouds
ECSVariableKeyword	Cloud Amount/Frequency
ProcessingLevelDescription	Geolocated Geophysical Quantities at Sensor Resolution
ProcessingLevelID	2
PlatformShortName	Aura
PlatformLongName	Aura EOS Polar Orbiting Satellite, 1:45 PM Ascending Equator
PlatformType	Spacecraft
PlatformCharacteristicName	OrbitInclination
PlatformCharacteristicDescription	Angle between the orbit plane and the Earth's equatorial plane
PlatformCharacteristicDataType	float
PlatformCharacteristicUnit	Degrees
PlatformCharacteristicValue	98.2
InstrumentShortName	OMI
InstrumentLongName	Ozone Monitoring Instrument
InstrumentTechnique	Nadir-Viewing Cross Track Imaging Spectroradiometry

NumberofSensors	2
SensorShortName	CCD Ultra Violet
SensorLongName	Charge Coupled Device Ultra Violet
SensorTechnique	Frame Transfer CCD Imaging Spectroradiometry
SensorCharacteristicName	CCD_UV_bandwidth
SensorCharacteristicDescription	The sensor's Ultra Violet wavelength range.
SensorCharacteristicDataType	varchar
SensorCharacteristicUnit	nm
SensorCharacteristicValue	270-380
SensorShortName	CCD Visible
SensorLongName	Charge Coupled Device Visible
SensorTechnique	Frame Transfer CCD Imaging Spectroradiometry
SensorCharacteristicName	CCD_VIS_bandwidth
SensorCharacteristicDescription	The sensor's Visible wavelength range.
SensorCharacteristicDataType	varchar
SensorCharacteristicUnit	nm
SensorCharacteristicValue	350-500
PrimaryCSDT	Complex Swath
Implementation	HDF-EOS
GranuleTimeDuration	6600

Table 12. Inventory metadata. Entries in blue are Product Specific Attributes.

Name	**Mandatory**	**Location**	**nr. of values**	**Type**	**Value**
SizeMBECSDataGranule	FALSE	DSS	1	Double	
ReprocessingPlanned	TRUE	DP	1	String	"Yes"
ReprocessingActual	TRUE	PCF	1	String	
DayNightFlag	TRUE	MCF	1	String	"Day"
LocalGranuleID	TRUE	PGE	1	String	Filename, as specified in section 2.2
LocalVersionID	TRUE	PCF	1	String	
ProductionDateTime	TRUE	TK	1	DateTime	
ParameterName	TRUE	PGE	1	String	"Cloud_Fraction_and_Pressure"
AutomaticQualityFlag	TRUE	PGE	1	String	*)
AutomaticQualityFlagExplanation	TRUE	PGE	1	String	**)
OperationalQualityFlag	TRUE	MCF	1	String	"Passed"
OperationalQualityFlagExplanation	TRUE	MCF	1	String	***)
ScienceQualityFlag	TRUE	MCF	1	String	"Not Investigated"
ScienceQualityFlagExplanation	TRUE	MCF	1	String	****)
QAPercentMissingData	TRUE	PGE	1	Integer	Percentage of pixels for which ProcessingQuality-Flags bit 7 or 9 is set.
QAPercentOutOfBoundsData	TRUE	PGE	1	Integer	Percentage of pixels for which the cloud fraction or cloud pressure is outside the boundaries set in the OPF
OrbitNumber	TRUE	PGE	1	Integer	
EquatorCrossingDate[1]	TRUE	PGE	1	Date	
EquatorCrossingTime[1]	TRUE	PGE	1	Time	
EquatorCrossingLongitude[1]	TRUE	PGE	1	Double	

ShortName	TRUE	MCF	1	String	"OMCLDO2" or OMCLDO2Z"
VersionID	TRUE	MCF	1	Integer	"0"
InputPointer	TRUE	PGE	20	String	
RangeBeginningDate[2]	TRUE	PGE	1	Date	
RangeBeginningTime[2]	TRUE	PGE	1	Time	
RangeEndingDate[2]	TRUE	PGE	1	Date	
RangeEndingTime[2]	TRUE	PGE	1	Time	
PGEVersion	TRUE	PCF	1	String	
AssociatedPlatformShortName	TRUE	MCF	1	String	"Aura"
AssociatedInstrumentShortName	TRUE	MCF	1	Aura	"OMI"
AssociatedSensorShortname	TRUE	MCF	1	String	"CCD Visible"
OperationMode	TRUE	PCF	1	String	"Global" or "Zoom"
NrMeasurements[1]	TRUE	PGE	1	Integer	Range(0,5000)
NrZoom[1]	TRUE	PGE	1	Integer	Range(0,5000)
NrSpatialZoom[1]	TRUE	PGE	1	Integer	Range(0,5000)
NrSpectralZoom[1]	TRUE	PGE	1	Integer	Range(0,5000)
ExpeditedData[1]	TRUE	PGE	1	String	"True" or "False"
SouthAtlanticAnomalyCrossing[1]	TRUE	PGE	1	String	"True" or "False"
SpacecraftManeuverFlag[1]	TRUE	PGE	1	String	"True" or "False"
SolarEclipse[1]	TRUE	PGE	1	String	"True" or "False"
InstrumentConfigurationIDs[1]	TRUE	PGE	256	Integer	Range(0,255)
MasterClockPeriods[1]	TRUE	PGE	256	Float	Range(0,255)
ExposureTimes[1]	TRUE	PGE	256	Float	Range(0,255)
PathNr[1]	TRUE	PGE	500	Integer	Range(1,466)
StartBlockNr[1]	TRUE	PGE	500	Integer	Range(1,500)
EndBlockNr[1]	TRUE	PGE	500	Integer	Range(1,500)

[1]) The value can be copied from the L1B Radiance metadata fields.

[2]) The value can be copied from the L1B Radiance metadata fields or set via the time tags in the PCF.

*) "Failed" if :
RadianceScienceQualityFlag is "Failed".
IrradianceScienceQualityFlag is "Failed".
The maximum of the following parameters is larger than or equal to the AutomaticQAFailed parameter in the OPF:
QAPctRadianceError
QAPctFitError
QAPctCloudFractionMissing
QAPctCloudPressureMissing

"Suspect" if:
RadianceScienceQualityFlag is "Suspect".
IrradianceScienceQualityFlag is "Suspect".
The maximum of the following parameters is smaller than the AutomaticQAFailed but larger or than or equal to the AutomaticQASuspect parameter in the OPF:
QAPctRadianceError
QAPctFitError
QAPctCloudFractionMissing
QAPctCloudPressureMissing

"Passed" for all other conditions.

**) "The value is based on a combination of the RadianceScienceQualityFlag, IrradianceScienceQualityFlag, QAPctRadianceError, QAPctFitError, QAPctCloudFractionMissing, QAPctCloudPressureMissing. Thresholds used: xx% for Failed and yy% for Suspect."

***) "This granule passed operational tests that were administered by the OMI SIPS. QA metadata was extracted and the file was successfully read using standard HDF-EOS utilities."

****) "An updated science quality flag and explanation is put in the product .met file when a granule has been evaluated. The flag value in this file, Not Investigated, is an automatic default that is put in every granule during production."

Table 13. Archive metadata.

Name	Location	Mandatory	# values	Type	Description
LongName	MCF	TRUE	1	String	"OMI/Aura Cloud Pressure and Fraction (O2-O2 Absorption) 1-Orbit L2 Swath 13x24km" for global products "OMI/Aura Cloud Pressure and Fraction (O2-O2 Absorption) 1-Orbit L2 Swath 13x12km" for zoom products
ESDTDescriptorRevision	MCF	TRUE	1	String	0.9.30

Table 14. Global Attributes of the OMI Level 2 O2-O2 Cloud data files.

Name	Data Type	nr	Description
InstrumentName	HE5T_NATIVE_CHAR	1	"OMI"
ProcessLevel	HE5T_NATIVE_CHAR	1	"2"
GranuleMonth	HE5T_NATIVE_INT	1	Month of start of granule (1-12)
GranuleDay	HE5T_NATIVE_INT	1	Day of start of granule (1-31)
GranuleYear	HE5T_NATIVE_INT	1	Year of start of granule (i.e. 2003)
TAI93At0zOfGranule	HE5T_NATIVE_DOUBLE	1	TAI time at 00:00 UTC at date of start of granule
PGEVersion	HE5T_NATIVE_CHAR	1	Version of the PGE
ProcessingSystem	HE5T_NATIVE_CHAR	1	"OFFLINE", "NRT" or "VFD"
CloudFractionHistogram	HE5T_NATIVE_INT32	10	Histogram of CloudFraction with bin size of 0.10
CloudPressureHistogram	HE5T_NATIVE_INT32	21	Histogram of CloudPressure with bin size of 50 hPa
CloudAlbedo	HE5T_NATIVE_FLOAT	1	Cloud albedo used to derive the cloud fraction and cloud pressure.
SolarProductMissing 0 Not set 1 Set	HE5T_NATIVE_INT	1	Set if the Solar product could not be opened, read, is in unexpected format or the data is missing
SolarProductOutOfDate 0 Not set 1 Set	HE5T_NATIVE_INT	1	Set if the Solar product could not be opened, read, is in unexpected format or the data is missing. The Backup product is used in this case.
SolarIrradianceWarning 0 Not set	HE5T_NATIVE_INT	1	Set if QAPctIrradianceWarning is larger than 0

1 Set			
BackupSolarProductUsed 0 Not set 1 Set	HE5T_NATIVE_INT	1	Set if the backup Solar product is used instead of the normal Solar product.
ParametersInconsistent 0 Not set 1 Set	HE5T_NATIVE_INT	1	Set if there is an inconsistency between the OPF parameters and the parameters of the LUTs.
RadianceParametersMissing 0 Not set 1 Set	HE5T_NATIVE_INT	1	Set if any of the general parameters from the L1B radiance product are missing.
SnowIceProductMissing 0 Not set 1 Set	HE5T_NATIVE_INT	1	Set if the SnowIce product could not be opened, read or is in unexpected format.
RadianceScienceQualityFlag	HE5T_NATIVE_CHAR	1	Set to the value set for the radiance product ScienceQualityFlag metadata attribute
IrradianceScienceQualityFlag	HE5T_NATIVE_CHAR	1	Set to the value set for the Solar product ScienceQualityFlag metadata attribute
QAPctSunGlint	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 GroundPixelQualityFlags bit 4 is set
QAPctEclipse	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 GroundPixelQualityFlags bit 5 is set
QAPctIrradianceWarning	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 0 is set
QAPctRadianceMissing	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 1 is set
QAPctRadianceError	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 2 is set
QAPctRadianceWarning	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 3 is set
QAPctNoSnowIceData	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 4 is set
QAPctFitError	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 5 is set
QAPctFitWarning	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 6 is set
QAPctCloudFractionMissing	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 7 is set
QAPctCloudFractionWarning	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 8 is set
QAPctCloudPressureMissing	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 9 is set
QAPctCloudPressureWarning	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 10 is set
QAPctExtrapolationWarning	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 11 is set
QAPctCloudFractionClippedWarning	HE5T_NATIVE_INT	1	Percent of ground pixels for which L2 ProcessingQualityFlags bit 12 is set
QAPctMeasMissing	HE5T_NATIVE_INT	1	Percent of measurements for which L2 MeasurementQualityFlags bit 0 is set
QAPctMeasError	HE5T_NATIVE_INT	1	Percent of measurements for which L2 MeasurementQualityFlags bit 1 is set
QAPctMeasWarning	HE5T_NATIVE_INT	1	Percent of measurements for which L2 MeasurementQualityFlags bit 2 is set
QAPctRebinned	HE5T_NATIVE_INT	1	Percent of measurements for which L2

			MeasurementQualityFlags bit 3 is set
QAPctSAA	HE5T_NATIVE_INT	1	Percent of measurements for which L2 MeasurementQualityFlags bit 4 is set
QAPctSpacecraftManeuver	HE5T_NATIVE_INT	1	Percent of measurements for which L2 MeasurementQualityFlags bit 5 is set
QAPctInstrumentSettingsError	HE5T_NATIVE_INT	1	Percent of measurements for which L2 MeasurementQualityFlags bit 6 is set
OPF_fittingWindow	HE5T_NATIVE_INT	1	OPF Setting
OPF_fittingWindowColumnRange	HE5T_NATIVE_INT	1	OPF Setting
OPF_level1ReadBufferSize	HE5T_NATIVE_INT	1	OPF Setting
OPF_level2WriteBufferSize	HE5T_NATIVE_INT	1	OPF Setting
OPF_fittingPolydegree	HE5T_NATIVE_INT	1	OPF Setting
OPF_meritFunction	HE5T_NATIVE_INT	1	OPF Setting
OPF_interpolationMethod	HE5T_NATIVE_INT	1	OPF Setting
OPF_amfAngleUpperLimit	HE5T_NATIVE_INT	1	OPF Setting
OPF_O3ReferenceTemperature	HE5T_NATIVE_INT	1	OPF Setting
OPF_O2O2ReferenceTemperature	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxNSolarWavelengthsFlagged	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxNEarthWavelengthsFlagged	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxNEarthWavelengthsFlaggedMissing	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxSolarWavelnPrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxEarthWavelnPrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxScdPrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxContinuumReferencePrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxCloudFractionPrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxCloudPressurePrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxFitRms	HE5T_NATIVE_INT	1	OPF Setting
OPF_opfVersion	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsSCD	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsContinuumReference	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsCloudFraction	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsCloudPressure	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsEarthRad	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsSolarIrrad	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxEarthRadPrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxSolarIrradPrecision	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsLatitude	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsLongitude	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsSZA	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsSAZ	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsVZA	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsVAZ	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsRAZ	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsSurfaceHeigth	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsSurfacePressure	HE5T_NATIVE_INT	1	OPF Setting
OPF_limitsSurfaceAlbedo	HE5T_NATIVE_INT	1	OPF Setting
OPF_albedoSnow	HE5T_NATIVE_INT	1	OPF Setting
OPF_albedoWater	HE5T_NATIVE_INT	1	OPF Setting
OPF_albedoLandThreshold	HE5T_NATIVE_INT	1	OPF Setting

OPF_albedoWaterThreshold	HE5T_NATIVE_INT	1	OPF Setting
OPF_albedoSeaIceNH	HE5T_NATIVE_INT	1	OPF Setting
OPF_albedoSeaIceSH	HE5T_NATIVE_INT	1	OPF Setting
OPF_ContinuumWavelength	HE5T_NATIVE_INT	1	OPF Setting
OPF_O3VcdFixed	HE5T_NATIVE_INT	1	OPF Setting
OPF_MaxFillInExtentDistance	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxSCDCovariance	HE5T_NATIVE_INT	1	OPF Setting
OPF_maxSolarIrradianceAgeInDays	HE5T_NATIVE_INT	1	OPF Setting
OPF_automaticQualityFailed	HE5T_NATIVE_INT	1	OPF Setting
OPF_automaticQualitySuspect	HE5T_NATIVE_INT	1	OPF Setting

3.6 Data File Size

The size of the data files depends on the number of measurements and whether it is generated from a Global or Zoom-in Level 1B product. Table 15 shows estimates for the data file for an orbit of Global data and part of the orbit of Global or Zoom-in data.

Table 15. Estimated data file sizes.

L1B Product	Duration [min]	Dimensions		File Size [Mbytes]	Size per Groundpixel [bytes]
		nTimes	nXtrack		
Global	53 (orbit)	1600	60	14.5 (TBC)	131 (TBC)
Global	10	300	60	TBD	TBD
Zoom-in	10	300	120	TBD	TBD

4 The Metadata File

4.1 Description

The metadata file contains the metadata of the granule. It is produced by call to the SDP Toolkit.

4.2 Format

The metadata file is in ASCII.

4.3 Structure

The metadata uses ODL.

Metadata Fields
The metadata fields for the ECS metadata are listed in tables 12, 13 and 14.